Programming Merit Badge
Updated: 5/5/2025

Important information about how to prepare for the merit badge
Prerequisites all requirements: 1, 2, 3, 4, 5 and 6

Parents, please review the content of a merit badge prior to registering your Scout: some badges may be challenging for younger Scouts. Also, the class discussions are more interesting if Scouts review *all* the requirements for the badge before the program. The chances of your scout completing all the work for the badge increases dramatically when they are properly motivated and the badge content is age-appropriate. Programming is a very analytical and academic in nature and will be easier for Scouts older than 13 years of age to complete.

Merit badges are not designed to be completed in a day and require independent work on the part of the Scout outside of the workshop.

A note on programming: The Scout will not be required to program anything from scratch to earn this badge. We will provide the code, the Scout will be asked to copy and paste the code into a working environment (they will be given a link to the environment) and run the code. Then make a few simple changes, and run it again. The goal is to expose the Scout to programming, not make them a programmer. We have a lot of resources for the Scout to use when accomplishing this! If the Scout is really interested in the topic, they will succeed with a little bit of effort.

Before attending, please make sure your Scoutmaster knows the Scout is taking this virtual merit badge class and indicates the Initial Unit Leader Signature in the merit badge in Scoutbook. [Click on the Scout in Scoutbook, click on their advancement, the merit badge and Initial Unit Leader Signature, enter a date.] (The Scoutmaster may alternately sign the front of a blue card for the badge. Blue cards are available here: https://support.grandcanyonbsa.org/wp-content/uploads/2022/11/mb-app-blue-card-fillable.pdf send the signed card to: bill.nelson@scouting.org)

IMPORTANT: For full credit for the badge, evidence of the requirements, as explained below, must be sent to: bill.nelson@scouting.org

The merit badge classes will be held in two sessions about 2-3 hours long each. We will go over many of the requirements in the classes and give the Scouts a lot of assistance on getting the requirements completed.

Though not required, Scout workbooks are useful and we prefer that Scouts use the workbook during the program. Requirements and workbooks can be found at: http://usscouts.org/mb/mb153.asp

About blue cards: We will utilize Scoutbook.com and record requirement completion online. Blue cards can be printed by parents and unit leaders in Scoutbook by clicking on the Scout, the Scout's advancement, the merit badge, and print blue cards.

Requirements

TYPE OR WRITE LEGIBLY AND WHERE NOT ASKED FOR A LIST, IN COMPLETE SENTENCES.

PUT YOUR NAME IN EMAILS TO ME AND IN ALL ATTACHMENTS

READ THE REQUIREMENTS CAREFULLY, YOU MUST ANSWER THE REQUIREMENTS AND PROVIDE WHAT IS BEING ASKED FOR.

COPY A PARENT OR GUARDIAN ON ALL CORRESPONDENCE

REQUIREMENTS

Prerequisites are requirements: 1, 2, 3, 4, 5 and 6

You need to do the prerequisites on your own. You need to send the completed requirements to: bill.nelson@scouting.org for credit when completed. (ALWAYS COPY A PARENT OR GUARDIAN)

First read the merit badge pamphlet. The requirements for this badge are a lot easier to finish if you read through the merit badge pamphlet first. The pamphlet for this badge is available free at this link: https://www.scouting.org/merit-badges/programming/

1. **Safety. Do the following:**

   a. View the Personal Safety Awareness "Digital Safety" video (with your parent or guardian's permission). Follow this link to the Personal Safety Awareness videos. (You do NOT need to earn Cyber Chip)

   Send me a screen image of any of the final scenes of the video.

   (b) Discuss first aid and prevention for the types of injuries that could occur during programming activities, including **repetitive stress injuries** and **eyestrain**.
   Use the workbook or Word document to answer this. We will follow up with a discussion in class.

2. History. Discuss with your counselor the history of programming and the evolution of programming languages, including at least three milestones related to the advancement or development of programming over time.
(Use the workbook or Word document to answer this requirement. We will follow up with a discussion in class.)

3. General Knowledge. Do the following:

   (a) Create a list of five popular programming languages in use today and describe which industry or industries they are primarily used in and why.
   For help on this requirement, see the video here:
   https://youtu.be/kJOqIaGwQ7Y?si=9lv5MonAHlaJp82K

   (b) Describe three different programmed devices you rely on every day.

4. Intellectual Property. Do the following:

   (a) Explain the four types of intellectual property used to protect computer programs.
   For help with this requirement, see the video here:
   https://youtu.be/Kb5c2Ousakc?si=VsRN78nYtQF3Nvqj

(b) Describe the difference between licensing and owning software.

(c) Describe the differences between freeware, open source, and commercial software, and why it is important to respect the terms of use of each.

For assistance with b and c, see the video here:
https://youtu.be/-tcaBH4o4qo?si=1W4AWMcnwec-nwF3

5. (see 5. Projects below)

6. Careers.

- Find out about three career opportunities that require knowledge in programming.

a. Pick one and find out the education, training, and experience required.

b. Discuss this with your counselor and explain why this career might be of interest to you.

Send me the information you have put together.

There is information here on career opportunities:
https://www.rasmussen.edu/degrees/technology/blog/programming-careers-for-coding-connoisseurs/

5. Projects.

There is a lot of information provided below. Don't get overwhelmed! If it looks confusing, we will go over it in class and it will become easy!

DON'T USE THE WORKBOOK FOR THIS REQUIREMENT. Instead follow the directions below.

For Programming requirement 5:

Here is the requirement:

5. With your counselor's guidance, select three different programming languages and development environments. For each sub-requirement below, do the following: Write or modify a program using the indicated programming language and development environment. The

program must take input and produce output based on computations and decisions made on the input. Debug and demonstrate the program to your counselor. Explain how each program processes inputs, makes decisions based on those inputs, and provides outputs based on computations and decision making.

(a) In the first language and environment, write or modify a program, debug and demonstrate, and explain as above.

With your counselor's approval, choose a sample program. Modify the code or add a function or subroutine to it. Debug and demonstrate the modified program to your counselor.

(b) In the second language and environment, write or modify a program, debug and demonstrate, and explain as above.

(c) In the third language and environment, write or modify a program, debug and demonstrate, and explain as above.

What I need:

For THREE(3) different programming languages, do the following:

1. Write or modify an existing program. (see link to samples in Information Document)

   The program must take input and produce output based on computations and decisions made on the input.
2. Debug and demonstrate the program to your counselor.
   Show me screen shots of the program and the program running (or a video)
3. Tell a story about what the program does. Explain (in words) how each program processes inputs, makes decisions based on those inputs, and provides outputs based on computations and decision making. **See the explanation on what is expected at the very end of this document.**

Do these 3 steps, 3 times, once for each programming language.

A video on how to complete this requirement is here: https://youtu.be/nkCo01-2Yjg

SUGGESTED LANGUAGES FOR REQUIREMENT 5

REMEMBER: YOU ONLY NEED TO DO THREE (3) LANGUAGES

Suggested language: **Visual Basic** (VBasic)

In the Education Industry; Difficulty: 1 out of 5 Visual Basic.NET is a thoroughly modernized language that will likely become the premier development tool for creating a wide range of .NET applications. .NET is a fancy way of saying a lot of the work is already done for you.

Go here for an example you can use for this requirement:
https://docs.google.com/document/d/1CYQrjLIwsPE6iEdg2BdkmsxH59DvIIAkIYLu2eH5Pdc/edit?usp=sharing

Help With Visual Basic

Visual Basic for Beginners video:
https://www.youtube.com/watch?v=HFWQdGn5DaU

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Suggested language: **Visual Basic for Applications (VBA)**

Business, Education, Engineering Industries – Difficulty 1 out of 5
Visual Basic for Applications (VBA) is an event-driven programming language developed by Microsoft. It is built into most desktop Microsoft Office applications, including Excel, Word, PowerPoint, and Access. VBA enables users to automate repetitive tasks, create custom forms, graphs, and reports, and add new functionality to Office applications. VBA is effective and efficient when it comes to repetitive solutions to formatting or correction problems. It is a simple, but powerful programming language that can be used to extend Office applications.

Go here for an example you can use for this requirement:
https://docs.google.com/document/d/1wzQGLyG43oBrBGM3cp4uTE5l3Ft9Vh_ne1uVhJnZ-U0/edit?usp=sharing

Help with VBA

A VBA tutorial of getting code written from Excel is here:
https://youtu.be/X6ZxqrXpbt0?si=Y9Y9T7kpbAGI8bmb

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Suggested language: Java

in the Business, Animation, Education, Engineering, Entertainment, Social Media, Mobile Devices, Science or Security example category Difficulty 2 out of 5. Java is a general purpose programming language in wide use.

Go here for an example you can use for this requirement:
https://docs.google.com/document/d/1Ao-RyKcrJHT_OwyKVWoRzZd1m2s6GEw7ks47LJJkvGw/edit?usp=sharing

Learning more Java

- There are a number of tutorials at http://docs.oracle.com/javase/tutorial/ And http://www.roseindia.net/java/
- This is a very good, short, beginner's tutorial: https://youtu.be/RRubcjpTkks?si=9rviC5lP2MKYzjzR
- Here is another Java Tutorial for beginners: https://www.youtube.com/watch?v=eIrMbAQSU34
- This video shows how to program a simple Java-based dice-rolling program. It is relatively easy to program. Write the program and make simple modification to it for the requirement. https://youtu.be/ucS3vwP9jnk?si=KksRKZlT6tViOW4d

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Suggested language: Python

in the Animation, Business, Entertainment, Engineering, Mobile Devices, or Science industry category. Example Difficulty 1 out of 5. It can run on nearly every device, which makes it very useful. Microsoft is even embedding it in future versions of MS Office!

Go here for an example you can use for this requirement:
https://docs.google.com/document/d/1M31530nVY3mWptbUPNyMARUsq9q9XYND3zRMUxEiM7E/edit?usp=sharing

Learn More Python:

- Here is a Python tutorial: https://youtu.be/b093aqAZiPU?si=kmwJaXUXRuTrneOU
- See this video for more samples: https://youtu.be/OXi4T58PwdM?si=4MCYQe8laKrR084q

- www.python.org/doc — The official documentation site for Python along with links to other tutorial and sample sites.
- Learnpython.org -– A step by step tutorial site. Starts with a "Hello World" program and extends into advanced language features.

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Suggested language: Javascript

in the Business, Entertainment, Internet/Social Media or Mobile Devices, industry category - Difficulty: 1 out of 5
Javascript is a programming language that is used to bring websites to life. You see it in action every time you visit a website that has any interaction. Learning Javascript is quick, easy and fun because you already have all the tools needed on your computer and you see the results instantly.

Follow the instructions on this page and create the program. Run it to see it work! Then modify it (they provide some suggested modifications.)
https://docs.google.com/document/d/1fnjVprxpPKHoUsvQhb_zhainjF4M51NNKYCqGU2B3xA/edit?usp=sharing

Learn More Javascript:

W3schools.com – A well organized tutorial with a lot of working examples and source code

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Suggested Language: C

C in the Animation, Business, Entertainment, Internet/Social Media or Mobile Devices, industry category – Example Difficulty: 2 out of 5
C is a general purpose programming language in wide use.

Follow the instructions on this page and create the program. Run it to see it work! Then modify it (they provide some suggested modifications.)
https://docs.google.com/document/d/1iHJnz1fRlHc4Fjdu1drVxYD3CE8YhCkZZz9n7bf587k/edit?usp=sharing

LEARN MORE

- http://www.cprogramming.com/tutorial.html

- http://www.tutorialspoint.com/cprogramming/

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Suggested Language: C++

C++ in the Animation, Business, Entertainment, Internet/Social Media or Mobile Devices, industry category – Example Difficulty: 2 out of 5
C++ is a general purpose programming language in wide use. Object-oriented languages such as C++ and Java leverage three principles called encapsulation, inheritance, and polymorphism to make programming more connected to concepts that people are familiar with.

Follow the instructions on this page and create the program. Run it to see it work! Then modify it (they provide some suggested modifications.)
https://docs.google.com/document/d/1TWeV2MDYbJqr9016jPTcZJSRCQMDUVT50PAGGujGe_0/edit?usp=sharing

LEARN MORE

There are some good C++ tutorials on the web.

http://www.cplusplus.com/doc/tutorial/
http://www.learncpp.com/
http://www.cprogramming.com/tutorial/c++-tutorial.html

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Suggested Language: Ruby

Ruby in the Business, Internet/Social Media or Mobile Devices, industry category – Example Difficulty: 1 out of 5
Ruby is a general purpose interpreted object oriented language popular for building websites (search Google for "Ruby on Rails"). It is similar to Python and Perl.

Follow the instructions on the page linked and create the program. Run it to see it work! Then modify it (they provide some suggested modifications.)
https://docs.google.com/document/d/1cmWHFp1HSGL-E1Vjgrv9CJyC_iZmnqIv1t0vmrdk9xs/edit?usp=sharing

LEARN MORE

- Programming Ruby – an excellent on line book
- Ruby in Twenty Minutes

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Suggested Language: Perl

Ruby in the Business, Internet/Social Media or Mobile Devices, industry category – Example Difficulty: 1 out of 5
Perl is a scripting language that is supported on all computing platforms (Windows, Unix, Linux, Mac, and mobile devices). It is called a scripting language because it executes immediately without the need for a compile step. This makes writing programs in Perl very fast, but the programmer has to keep track of the variables being used and make sure they are set before they are tested.

Follow the instructions on the page linked and create the program. Run it to see it work! Then modify it (they provide some suggested modifications.)
https://docs.google.com/document/d/1uQTFvWwDmKG1aRqaXLNxkw9ACrtcqMaUCtFo4KNH4u0/edit?usp=sharing

LEARN MORE

- learn.perl.org — This site has many examples and other tutorials.
- Perl-tutorial.org -— This hub site has links to many other tutorials and examples.
- Cpan.org -— Comprehensive Perl Archive Network. Contains many libraries of pre-written programs that can be downloaded and used in your projects. Animation, graphics, encryption, and network utilities are just a few of the kinds of resources available.

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Suggested Language: C Sharp (C#)

Animation, Business, Engineering, Entertainment, Internet/Social Media or Mobile Devices, industry category – Example Difficulty: 2 out of 5
C# (pronounced C-Sharp) is a general purpose object oriented programming language developed by Microsoft for the Windows platform. It uses the .NET platform, which is a fancy way of saying that a lot of the work has been done for you — you just write a program that takes advantage of all the code that has already been written.

Follow the instructions on the page linked and create the program. Run it to see it work! Then modify it (they provide some suggested modifications.)
https://docs.google.com/document/d/1Cg3sTUXDMDtgk-8qfpqwG2R0SGBDjKfwjmTNJ1yn8ck/edit?usp=sharing

LEARN MORE

- learn.perl.org — This site has many examples and other tutorials.
- Perl-tutorial.org -— This hub site has links to many other tutorials and examples.
- Cpan.org -— Comprehensive Perl Archive Network. Contains many libraries of pre-written programs that can be downloaded and used in your projects. Animation, graphics, encryption, and network utilities are just a few of the kinds of resources available.

Suggested Language: Swift

Business, Internet/Social Media industry category – Example Difficulty: 1 out of 5

Swift is a general-purpose, open-source programming language designed by Apple. It is mainly used for native iOS and macOS development. Some popular apps such as LinkedIn, Lyft, and WordPress are written in Swift. Swift is fast, safe, and easy to use, with a modern syntax accessible to beginners and experienced programmers. It is also designed for safety, eliminating entire classes of unsafe code. Swift code is safe by design and produces software that runs lightning-fast. Swift is also open source and has a package manager.

Follow the instructions on the page linked and create the program. Run it to see it work! Then modify it (they provide some suggested modifications.)
https://docs.google.com/document/d/1C5It1Kr8pJrnRULryb0kog-f_xgH3xfqmPhMpi53wx4/edit?usp=sharing

LEARN MORE

1. **Swift Programming Tutorial for Beginners (Full Tutorial)**: This video tutorial covers the basics of Swift programming, including how to install and use Xcode, create and run a playground, declare and use variables and constants, perform operations on variables and constants, use different data types, and print values to the console using the print keyword. The tutorial is 3 hours and 22 minutes long and is available on YouTube [1].
2. **Swift Programming Tutorial | FULL COURSE | Absolute Beginner**: This video tutorial is a full course on Swift and iOS development for absolute beginners. It covers the basics of Swift programming, including variables

and constants, data types, math operators, if statements, switch statements, for-in loops, while loops, functions, classes, subclassing, UIKit, initializers, optionals, properties, arrays, and dictionaries. The tutorial is 10 hours and 32 minutes long and is available on YouTube [2].

3. **(2020) Swift Tutorial for Beginners: Lesson 1**: This video tutorial is a beginner-friendly tutorial that covers the basics of Swift programming, including how to download and install Xcode, create and use a playground, write Swift code to create variables, use the print command to output data to the console area, and assign new data to existing variables. The tutorial is 21 minutes long and is available on YouTube [3].

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Suggested Language: HTML (Hypertext Markup Language)

Business, Internet/Social Media industry category – Example Difficulty: 2 out of 5
HTML is an essential programming language for web developers and designers who work on the Internet. It helps both professionals and novices make simple web pages, create WordPress pages, optimize for SEO, and even write blogs regarding its uses. Knowledge of HTML is also necessary for those who want to learn other programming languages, as it makes the process of understanding them easier.

Follow the instructions on the page linked and create the program. Run it to see it work! Then modify it (they provide some suggested modifications.)
https://docs.google.com/document/d/1ZCpI1OmgiZ3v9lLljh7-ok_5E_8W1WzcYrIuTdizzQU/edit?usp=sharing

LEARN MORE

- https://youtu.be/MDLn5-zSQQI?si=9GEvGEvahMbL-hOA — HTML for beginners.
- **W3Schools**: W3Schools provides a comprehensive HTML tutorial that covers all aspects of HTML, including HTML elements, attributes, events, color names, entities, character-sets, URL encoding, language codes, HTTP messages, browser support, and more. The tutorial is easy to follow and includes examples, exercises, and quizzes. You can access the tutorial at [1].

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Suggested Language: PHP

Business, Internet/Social Media industry category – Example Difficulty: 1 out of 5
PHP is a language that is used on web servers to merge web page output with

optional content or results from a database or user input. Web pages by themselves are static, but intelligence placed on the web server through programs (like PHP) allow a web page to change based on data it gets from the user or from other sources.

PHP is not a stand-alone language, it requires a web server like Apache or IIS to be running to send it the user input. However, you can compile and run it on the https://www.onlinegdb.com/ compiler.

Follow the instructions on the page linked and create the program. Run it to see it work! Then modify it (they provide some suggested modifications.) https://docs.google.com/document/d/1H4wdubhKOEArB0rAquy0FBgEfrCY8xLPkke4JLjZBhc/edit?usp=sharing

LEARN MORE

- http://www.php.net/manual/en/ — The official documentation site for PHP.
- http://www.w3schools.com/php/ — A step-by-step tutorial site that contains lots of useful sample code.
- Google.com –- Search for other code and samples.

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Or use other languages of your choosing. You can find example languages here: https://scoutlife.org/merit-badges/programming-merit-badge/

How to do the last part of requirement 5:

Here is the last part of requirement 5: "Explain how each program processes inputs, makes decisions based on those inputs, and provides outputs based on computations and decision making."

Explanation for Scouts

This part of the requirement is asking you to describe how your program works, step by step, like explaining how you solve a math problem or play a game. You need to show how your program:

- Takes Input: This is the information the program gets from the user, like when you type your name, a number, or click a button. Think of it as the program "listening" to what you tell it.

- Makes Decisions: The program uses the input to decide what to do next, like choosing a path in a choose-your-own-adventure book. It might check if a number is big or small, or if a word matches something specific, using "if-then" rules (like "if the number is greater than 10, do this").
- Does Computations: The program does some "math" or logic with the input, like adding numbers, counting letters, or figuring out a score. This is where it processes the information to create something new.
- Gives Output: Finally, the program shows or tells you the result, like displaying a message on the screen, printing a number, or showing a picture. This is the program's way of "talking back" to you.

You're telling the story of how your program starts with input, thinks about it, does some work, and then shares the answer.

Example to Illustrate

Let's use a simple program idea: a program that decides if a student passes a class based on their test score. Below is an example in Python, followed by an explanation of how it meets the requirement.

Sample Program (Python)

Python

```
# Program: Check if a student passes based on their test score
score = int(input("Enter your test score (0-100): "))  # Get input

if score >= 60:  # Decision making
   result = "You passed!"
else:
   result = "You did not pass."

print(result)  # Output the result
```

Explanation for the Requirement

Here's how you can explain this program to your counselor, step by step, to meet the requirement:

- Processes Inputs:
    - The program asks the user to type their test score, which is a number between 0 and 100.

        - It uses the input() function to get this number and stores it in a variable called score. For example, if the user types "85", the program saves score = 85.
- Makes Decisions Based on Inputs:
    - The program checks if the score is 60 or higher using an if statement.
    - It decides what to do based on this check:
        - If score >= 60, it sets the result to "You passed!".
        - If score < 60, it sets the result to "You did not pass.".
    - For example, if the input is 85, the program sees that 85 is greater than or equal to 60, so it chooses the "You passed!" message.
- Provides Outputs Based on Computations and Decision Making:
    - The program doesn't do complex math here, but it computes the decision by comparing the score to 60.
    - After deciding, it stores the result in the result variable.
    - It then uses the print() function to show the result to the user. For example, if the score was 85, the program outputs "You passed!" on the screen.

Applying to Other Languages

The requirement asks for three different programming languages. The explanation process is similar regardless of the language. For example:

- JavaScript: If they write a web-based program that changes text color based on a user's choice, the input is the color choice, the decision is checking if the choice is valid, and the output is the updated text color.
- Scratch: If they create a game where a character moves based on key presses, the input is the key press, the decision is which direction to move, and the output is the character's movement on the screen.

Example for Another Language (Scratch)

In Scratch, students might create a program where a sprite says whether a number is "big" or "small":

- Input: User types a number into an "ask" block.
- Decision: An "if-else" block checks if the number is greater than 50.
- Computation: The program decides the message ("Big!" or "Small!").

- Output: The sprite says the message. They can explain: “The program asks for a number, checks if it’s bigger than 50, and then makes the sprite say ‘Big!’ or ‘Small!’ based on that.”